GORDON DAM

Tasmania

Submission for an

NATIONAL ENGINEERING LANDMARK

from

The Engineering Heritage Committee
Tasmania Division
The Institution of Engineers, Australia

September 2000

GORDON DAM

CONTENTS

INTRODUCTION

Gordon Dam is a 140m high double-curvature arch dam in southwest Tasmania. The site is a deep narrow gorge where the Gordon River, on its westward path to Macquarie Harbour, has cut through a north-south oriented mountain range, dividing it into the Hamilton Range to the north and the Wilmot Range to the south.

The purpose of the dam is to store the flow in Tasmania's largest river and to raise its level for power generation in the Gordon underground power station. Additional water from the Serpentine and Huon Rivers is collected in nearby Lake Pedder and diverted through McPartlans Pass Canal into Lake Gordon. The flooding of the original small natural Lake Pedder was strongly opposed by the conservation movement, and there were two parliamentary inquiries.

This power development was easily the most economical one available to the Hydro-Electric Commission at the time and on completion it supplied about 25% of Tasmania's electricity. The power station initially contained two 150MW machines and a third machine of the same size has been added. Lake Gordon is the largest lake in Australia (12,450,000ML) and it provides vital security for the hydro system during drought conditions.

Before the Gordon River Power Development was approved by Parliament in 1967, there were no roads into southwest Tasmania. A road 80km long was built from Maydena to the dam site in order to construct the scheme. The route traversed heavily-timbered country, rugged mountain ranges and open button grass plains. While the road was being built, access to the investigation camp at the site was by helicopter.

Strathgordon village was established to house the staff and workforce for the construction of the development. Although the village had most facilities, it was some time before the people became accustomed to the high annual rainfall (about 4000mm) and the long drive to Hobart (140km). The eventual sealing of the road made the journey less of a trial.

The geology of the rocks forming the gorge is quite complex and the dam had to be carefully sited to avoid several prominent faults in the abutments. A major excavation was required on the left abutment, and there are extensive tunnels at several levels in both abutments for foundation grouting and drainage purposes.

By the time Gordon Dam was being designed, the complex mathematical computations required to determine the stresses in the concrete under gravity and water loading could be carried out by computer. Thus many analyses were undertaken, and the curved shape and arch thicknesses were progressively adjusted to minimise the concrete quantity and keep the stresses within the allowable limits. The highly satisfactory outcome was an arch shell varying in thickness from 2.75m at the top to 17.7m at the bottom, and a concrete volume of 154,000m^3. The stresses were verified by loading a scale model of the dam in a laboratory, and later by a finite element analysis. All three methods produced similar results. In the vertical direction the dam leans upstream near the base and downstream over the top two-thirds of its height. The horizontal curvature also varies and the thickness increases near the abutments.

Gordon Dam is a popular tourist destination. From the visitors' centre above the dam there is a spectacular and much photographed view of the gorge, the dam and the lake. The depth of the gorge and the double curvature of the dam are readily apparent.

The dam was designed and constructed by the Hydro-Electric Commission, Tasmania using its own staff and workforce.

Main Dimensions:

Type	Thin double-curvature concrete arch
Height	140m
Length	190m
Crest thickness	2.75m
Base thickness	17.7m
Concrete volume	15,300m^3
Storage volume	12.45 million ML
Spillway capacity	Not applicable
Gordon Power Station	450MW installed capacity

Commemorative Plaque Nomination Form

Date.....***September 2000***

To:

Commemorative Plaque Sub-Committee
The Institution of Engineers, Australia
Engineering House
11 National Circuit
BARTON ACT 2000

From…***Tasmania Division***
Nominating Body

The following work is nominated for an ***Historic Engineering Marker***

Name of work.....***GORDON DAM***

Location, including address and map grid reference if a fixed work.....***On the Gordon River, 120km west of Hobart. Grid ref***: ***E416 000 N 268 541 Tas Map Sheet 8012***

Owner.....***Hydro-Electric Corporation***

The owner has been advised of the nomination of the work and has given approval:

Copy of letter attached

Access to site.....***by road from Hobart via Maydena***

Future care and maintenance of the work.... ***Will be maintained by the Hydro-Electric Corporation as part of the Gordon River Power Development.***

Name of sponsor.....***Engineering Heritage Committee, Tasmania Division***

For an NEL, is an information plaque required?.....***Yes***

……
Chairperson of Nominating Committee

……
Chairperson of Division Heritage Committee

ADDITIONAL SUPPORTING INFORMATION

Name of work..... ***GORDON DAM***

Year of construction or manufacture..... ***Completed 1974***

Period of operation ..... ***Continuous since 1974***

Physical condition ..... ***Excellent***

Engineering Heritage Significance:

Technological/scientific value ..... ***Yes***

Historical value ..... ***Yes***

Social value ..... ***Yes***

Landscape or townscape value..... ***Yes***

Rarity..... ***Yes***

Representativeness ..... ***Yes***

Contribution to the nation or region..... ***Yes***

Contribution to engineering..... ***Yes***

Persons associated with the work..... ***Yes***

Integrity..... ***Yes***

Authenticity..... ***Yes***

Comparable works (a) in Australia..... ***Yes***

(b) overseas..... ***Many***

Statement of significance, its location in the supporting doco… ***Next page***

Citation (70 words is optimum)…..

NATIONAL ENGINEERING LANDMARK

GORDON DAM

THIS 140M HIGH CONCRETE ARCH DAM WAS COMPLETED IN 1974. IT IS THE HIGHEST ARCH DAM AND LAKE GORDON IS THE LARGEST STORAGE IN AUSTRALIA (12.4 MILLION ML). THE USE OF DOUBLE-CURVATURE ENABLED THE DAM'S CONCRETE VOLUME TO BE REDUCED TO 15,400M^3. THE DAM IS A TOURIST ATTRACTION AND IS ASSOCIATED WITH THE CONSTRUCTION OF THE FIRST ROAD AND THE FIRST VILLAGE IN SOUTHWEST TASMANIA, AND WITH THE CONTROVERSY OVER FLOODING OF LAKE PEDDER. (74 words)

Dedicated by the Institution of Engineers, Australia 2001

Attachments to submission (if any)..... ***See contents***

Proposed location of plaque (if not a site)..... ***Not applicable***

STATEMENT OF SIGNIFICANCE

GENERAL

Gordon Dam has been nominated for listing on the Register of the National Estate. For that purpose a comprehensive Nomination was prepared in accordance with Australian Heritage Commission requirements. In that document the heritage significance of the dam was tested against nine National Estate criteria. Much of the material for this submission has been extracted from that document.

TECHNOLOGICAL/SCIENTIFIC VALUE

Gordon Dam is the highest and most recent (as at 1999) arch dam built in Australia. It is an excellent example of the economy which can be achieved by using the double-curvature shape to reduce stresses in critical areas. The facility of having the HEC Arch Dam stress analysis programme enabled the designer to make multiple analyses. By this means the shape and the thickness were progressive refined to minimise the concrete volume while keeping the stresses within the allowable limits. The calculated stresses were verified by comparison with those measured on a scale model and those produced using the finite element method. Good agreement was found. The result has been an economical state-of-the-art structure which has performed very well in service.

The control of water pressure in the abutments by an extensive drainage system is a feature of this dam. Horizontal tunnels were excavated at several levels on each abutment, and near-vertical drain holes were drilled from one tunnel to the one below to form a near-vertical drainage curtain. The drains collected any seepage passing through the grout curtain farther upstream, and prevented the development of pore pressures which could reduce the stability of the dam abutments.

Another feature is the instrumentation system which relies mainly on embedded piezometers to measure pore pressures in the abutments and on the accurate measurement of deflections, to verify the behaviour of the dam over time. Deflection measurements are made by a Mekometer sighting on targets on the downstream face of the dam, supplemented by plumb lines located inside the dam.

HISTORICAL VALUE

The first road and the first village in southwest Tasmania were built for the construction of the dam and the power development. The associated studies of the fauna, flora, geology, exploration and history of the southwest added greatly to the knowledge of this hitherto undeveloped quarter of the island.

SOCIAL VALUE

The Gordon River Power Development added substantially to the capacity of Tasmania's electricity generating system, catering for the rapidly growing demand and attracting new industries.

LANDSCAPE VALUE

Vistors to the Gordon Dam Visitors Centre look down on a spectacular view encompassing the deep rugged gorge, the majestic curved dam and the extensive lake. This striking panorama is much photographed and always remembered by its visitors.

RARITY

About 48 arch dams have been built in Australia. Only nine have double curvature. Gordon Dam is almost twice the height of the next highest arch dam.

REPRESENTATIVENESS

The dam is an excellent example of a modern high double-curvature arch dam.

CONTRIBUTION TO NATION OR REGION

The main contribution is in the production of electrical energy from a clean renewable resource.

CONTRIBUTION TO ENGINEERING

The procedures used in the design of Gordon Dam were presented at an International Symposium on Criteria and Assumptions for the Numerical Analysis of Dam in the UK (Giudici, 1975). Papers on the performance of the dam have been presented in Switzerland (Giudici, 1979) and New Zealand (Giudici, 1980).

PERSONS ASSOCIATED WITH THE WORK

The following HEC engineers were associated with the work:

John Wilkins	Asst Chief Civil Engineer Design (later Chief Civil Engineer)
Bill Mitchell	Engineer Design Group 3 (later Chief Civil Engineer)
Mike Fitzpatrick	Section Engineer Dams 2 (later Chief Civil Engineer and Asst General Manager Engineering))
Neville Boughton	Senior engineer
Sergio Giudici	Senior engineer (later General Manager Consulting)
Ted Hofto	Project Manager Gordon
Alan Varty	Engineer-in-charge Gordon Dam

INTEGRITY

The dam remains in excellent condition. There is a substantial crack low down on the left abutment which carries a small leakage flow but has no effect on the safety of the dam. The crack is attributed to the effects of shrinkage and temperature. The behaviour of the dam is monitored regularly and remains entirely satisfactory.

AUTHENTICITY

The dam remains in its as-constructed condition.

COMPARABLE WORKS

(a) The three highest double-curvature arch dams in Australia are:

NAME	DATE	HEIGHT	STATE
Gordon	1974	140m	Tas
Tumut Pond	1958	86m	NSW
Devils Gate	1969	84m	Tas

(b) There are a large number of comparable arch dams in other countries, notably in Europe and the United States.

REFERENCES

1. Allen D T "Abutment Stability Studies for the Gordon Arch Dam", *Proceedings of the First Australia & New Zealand Conference on Geomechanics (Melbourne)*, August, 1971, p.298-306.

2. Allen D T "Temperature Control of Mass Concrete for Gordon Arch Dam", *Australian National Committee on Large Dams Bulletin No. 41*, March 1975, p.16-21.

3. Andric M, G T Roberts and R K Tarvydas, "Engineering Geology of the Gordon Dam, South West Tasmania", *Quarterly Journal of Engineering Geology*, Volume 9, 1976, p.1-24.

4. Barnett R H W and S Giudici, "Behaviour and Surveillance of Gordon Dam", in J L Serafim ed., *Safety of Dams*, A.A. Balkema, Rotterdam, International Conference on Safety of Dams (*Coimbra, Portugal*), 1984, p.107-113.

5. Giudici S, R Courtier and T J Szczepanowski "The Gordon Cofferdam Design and Construction", *11th International Commission on Large Dams Congress (Madrid)* 1973, Q.42, R.1, p.

6. Giudici S, W R Mitchell and M D Fitzpatrick, "Procedures in Arch Dam Analysis and Design", *International Symposium on Criteria and Assumptions for Numerical Analysis of Dams, (Swansea, UK)*, September 1975, p.132-148.

7. Giudici S "Measurement of Rock Deformation in the Abutment of an Arch Dam", *4th International Congress for Rock Mechanics* (Montreaux), 1979, p.167-173.

8. Tasmanian Hydro-Electric Commission, "Description of the Gordon River Power Development", *Australian National Committee on Large Dams Bulletin* No. 40, September, 1974, p.31-33; continued in No. 41, March, 1975, p.22-26.

9. Jenkins D M and K W Funnell "Dam Deformation Surveys in Tasmania", *Proceedings 14th Annual Congress, Institution of Surveyors Australia (Hobart)*, 13-19 February 1971, p.119-142 plus figures.

10. Lack L J and A J Bowling "Investigation into the Structural Behaviour of Arch Dams by means of Model Tests", *Proceedings 4th Australian Conference on the Mechanics of Structures and Materials (Brisbane)*, August, 1973, pp.121-128.

11. Linton J W S and D M Jenkins "Surveys for the Gordon Power Development - Stage 1", *Proceedings 17th Annual Congress Institution of Surveyors Australia (Melbourne)* 1974, p.136-154.

12. Thomas H H, "The Gordon River Hydro-Electric Development, Stage 1", *Water Power*, March 1971, p.85-92.

13. "John Kirby Wilkins, Engineer of Gordon River Dam", obituary, The *Australian*, Time and Tide 22 January 1997.

14. *World Register of Dams,* International Commission on Large Dams, Paris 1984.

ADDED April 2001:

16. Fitzpatrick M D, "Gordon Dam. Nomination for Listing on the Register of the National Estate", May 1998.
17. Gordon Dam: AHC Register of the National Estate: Database number 101593.

Hydro

Hydro-Electric Corporation
ARBN - 072 377 158

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Hobart Tasmania 7001

4 Elizabeth Street
Hobart Tasmania 7000

Telephone (03) 6237 3400
Fax: (03) 6230 5823

Our Ref.
Your Ref.
Ask for

24 February 2000

Mr K C Drewitt
Chairman
Engineering Heritage Committee
The Institute of Engineers
2 Davey Street
Hobart Tas 7000

Dear Mr. Drewitt,

Thank you for your correspondence of 14 February 2000, advising of the eight dams which have recently been nominated for national heritage listing on the National Estate Register.

The Hydro is very pleased to approve the nominations and we look forward to hearing the outcome of the proposed public recognition awards.

With kind regards,

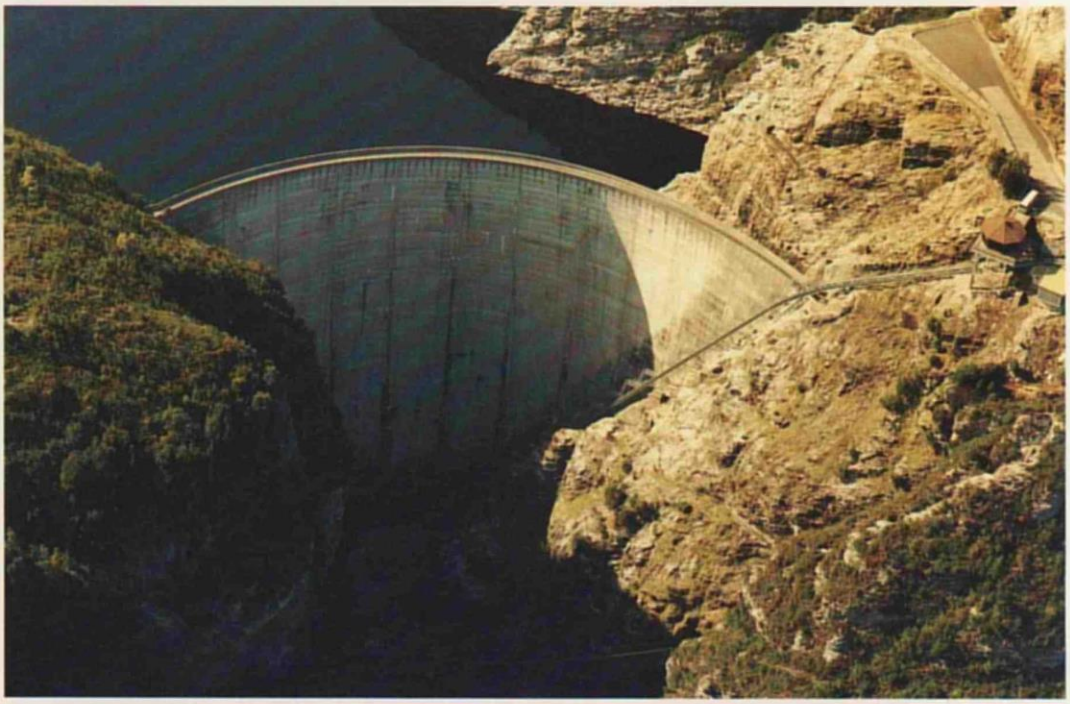
Yours sincerely,

Roger Gill
Generation Manager Generation

c.c. Andrew Pattle, Dam Safety Manager
Peter Grierson, Manager Power Schemes

GORDON DAM

AUSTRALIA



TYPE: Double-curvature concrete arch
HEIGHT: 140 m CREST LENGTH: 198 m
CONCRETE VOLUME: 154 000 m^3
STORAGE VOLUME: 12 450 million m^3
COMPLETED: 1974
OWNER: Hydro-Electric Commission of Tasmania

Gordon Dam is the main dam of the Gordon River Power Development, 120 km west of Hobart. It is the highest dam in Tasmania, and the lake it forms is the largest storage in Australia. The project involved four dams, a small canal, the headrace and tailrace tunnels, the underground power station, 70 km of highway-standard road and a town which housed two thousand people. Near the dam there is also an 80 m high intake tower.

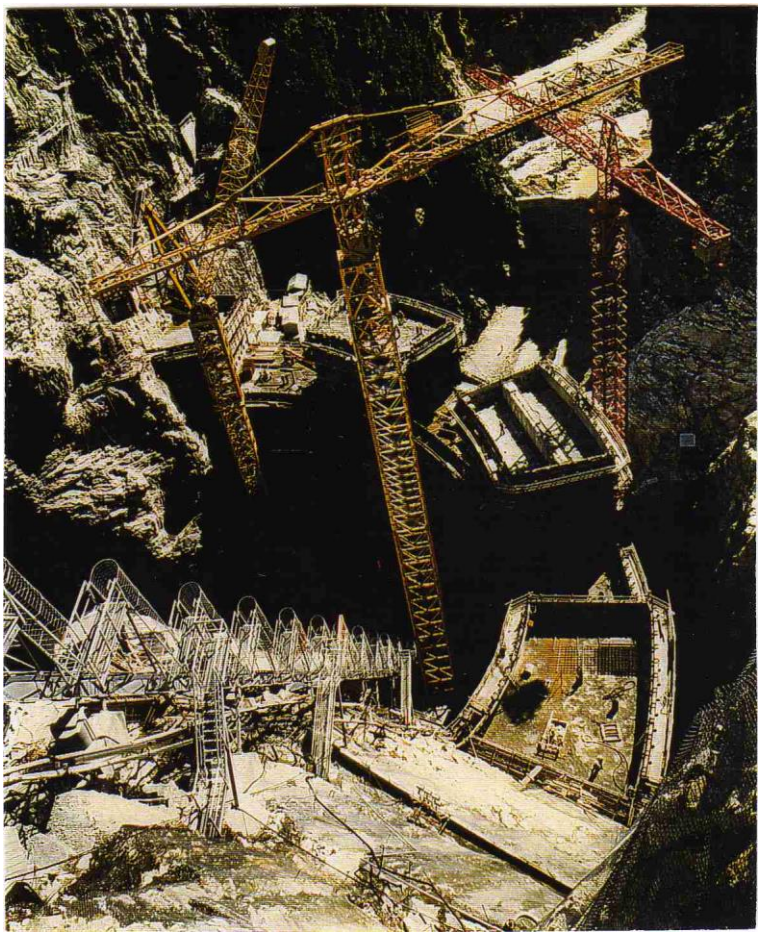
The dam is set in a deep gorge in intensely folded quartzite which is intersected by several major faults. To safeguard the stability of the abutments, there is an array of drainage adits interconnected by bore-holes. The adits also gave access for the curtain grouting just upstream of the drainage zone.

The arch is of an asymmetrical, multiple-radius form to suit the different slopes of the left and right abutments. It varies in thickness between 17.7 m at the base and 2.8 m at the crest.

There is no spillway associated with Gordon Dam. The lake is so large that the fluctuation in water level is very gradual, and the flow is easily accommodated by the power station. If the power station is ever out of commission for a long period, water can be released either through McPartlan Pass Canal or, in an emergency, through a removable portion of the crest walls.

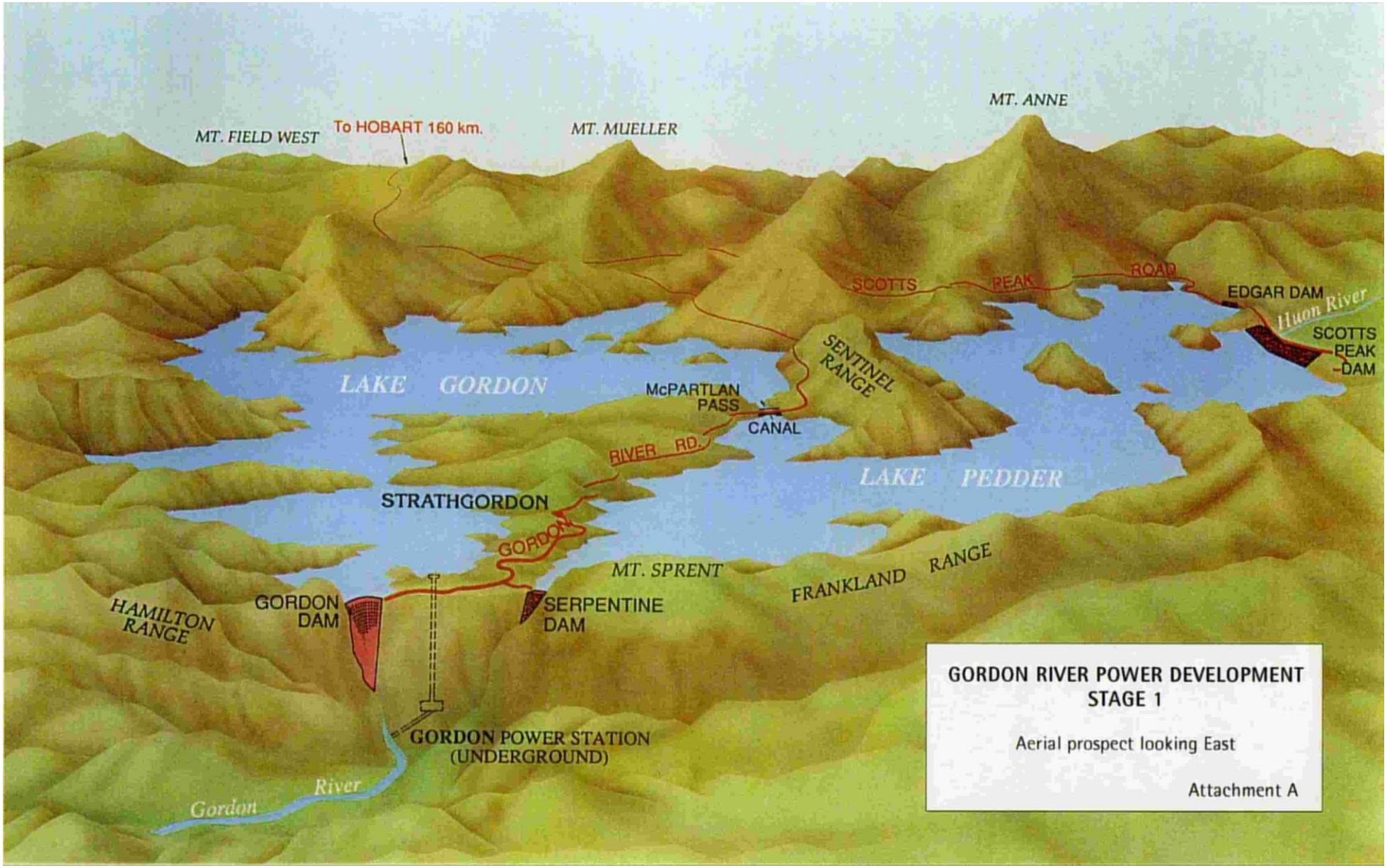
Services Provided
Feasibility study, investigations, detailed design, documentation, supervision of construction, operation and maintenance.

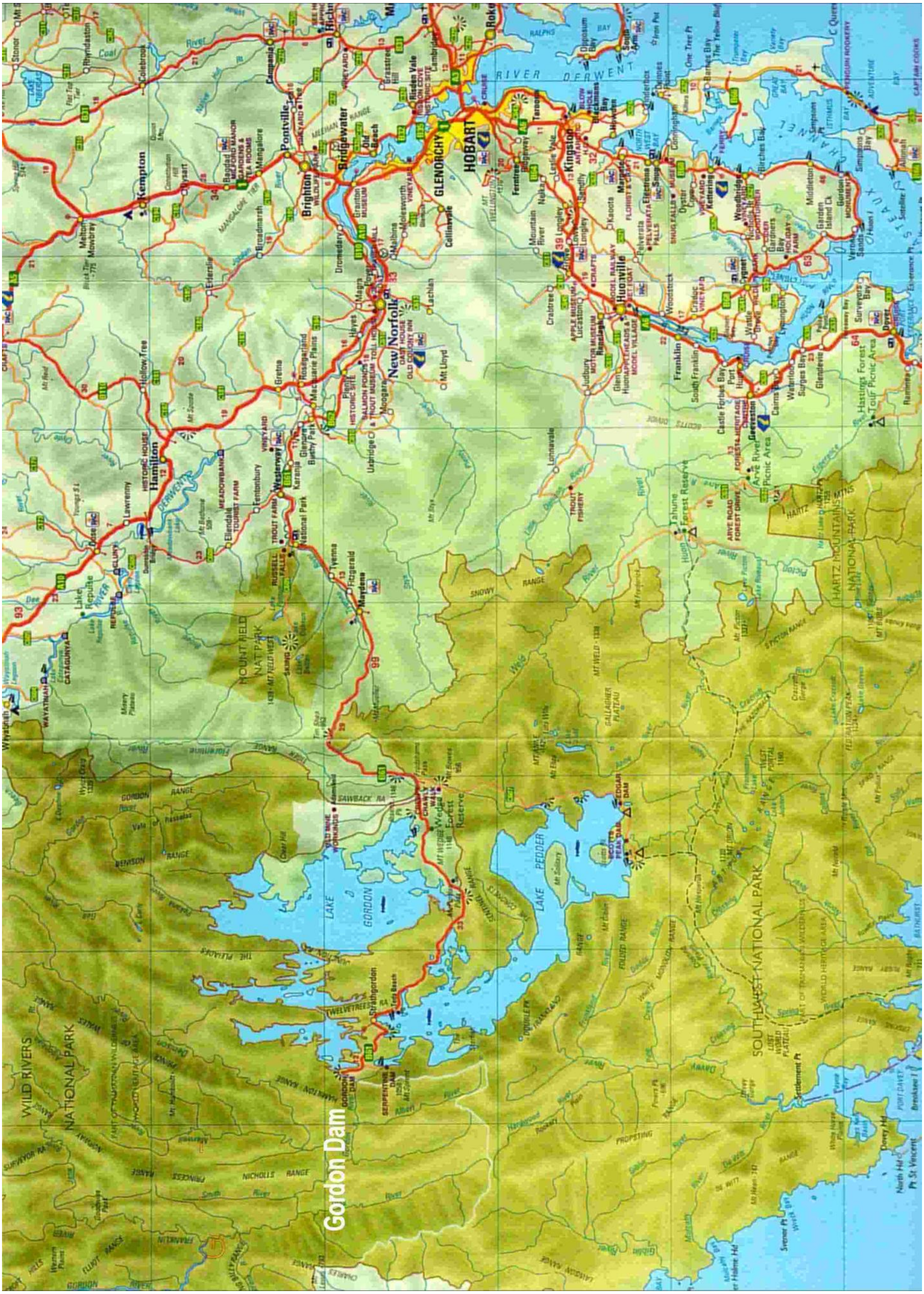
HEC

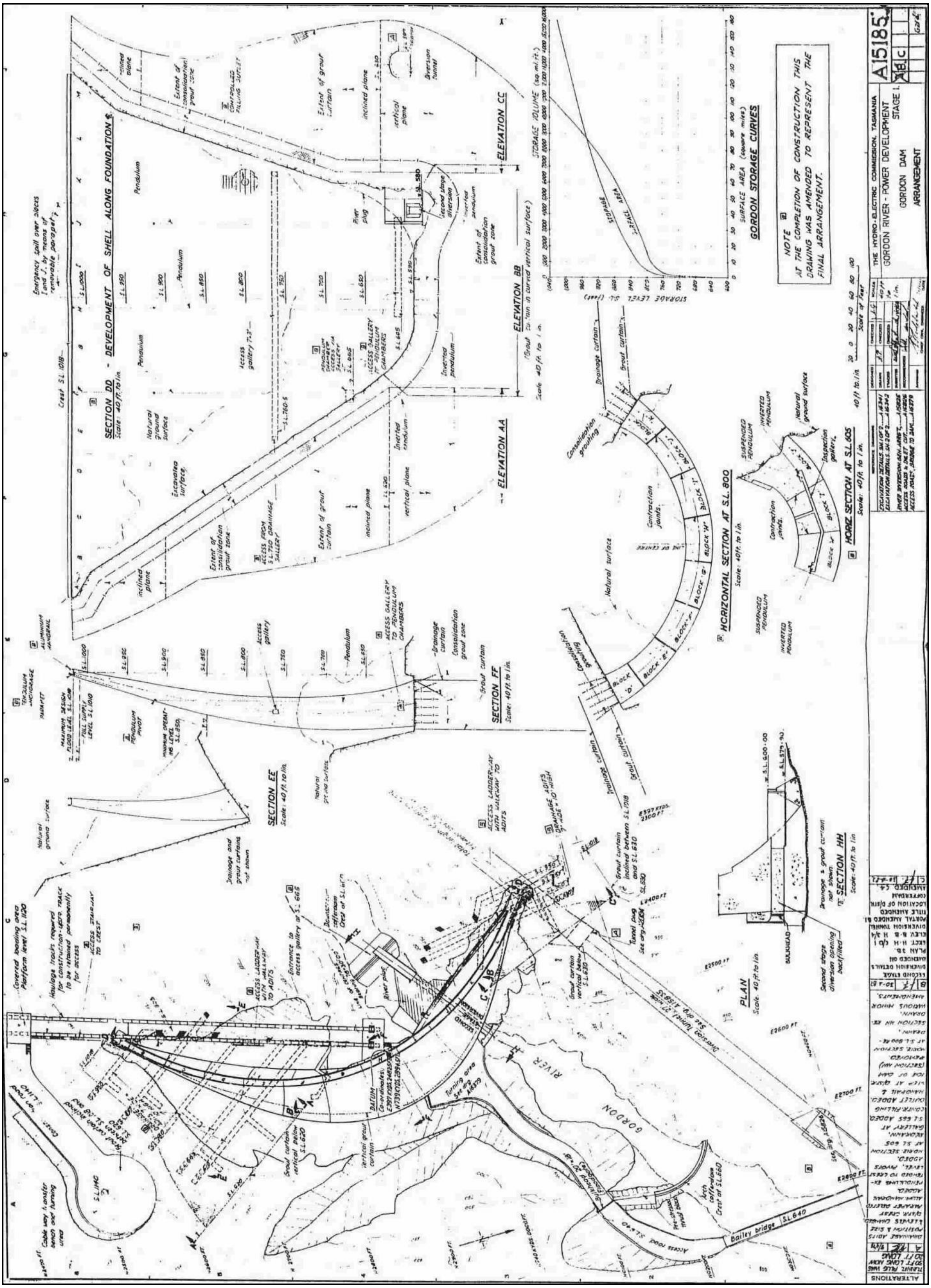


Gordon Dam under construction; the variable arch thickness approaching the abutment can be observed bottom right.

Aerial view of Gordon Dam with Lake Gordon close; crest length is 198 m and thickness 2.75 m.


MT. ANNE
MT. FIELD WEST
To HOBART 160 km.
MT. MUELLER
SCOTTS PEAK ROAD
EDGAR DAM
Huon River
SCOTTS PEAK DAM
SENTINEL RANGE
LAKE GORDON
McPARTLAN PASS
CANAL
RIVER RD.
LAKE PEDDER
STRATHGORDON
GORDON
MT. SPRENT
FRANKLAND RANGE
HAMILTON RANGE
GORDON DAM
SERPENTINE DAM
GORDON POWER STATION (UNDERGROUND)
Gordon River
GORDON RIVER POWER DEVELOPMENT STAGE 1
Aerial prospect looking East
Attachment A


Gordon Dam
HOBART
GLENORCHY
New Norfolk
Huonville
Kingston
LAKE GORDON
LAKE PEDDER
SOUTHWEST NATIONAL PARK
WILD RIVERS NATIONAL PARK
HARTZ MOUNTAINS NATIONAL PARK
MOUNT FIELD NAT PARK
RIVER DERWENT
Strathgordon
Maydena
National Park
Hamilton
Bridgewater
Brighton
Kempton


THE HYDRO-ELECTRIC COMMISSION, TASMANIA
GORDON RIVER - POWER DEVELOPMENT
STAGE 1
GORDON DAM
ARRANGEMENT
A15185
SECTION DD - DEVELOPMENT OF SHELL ALONG FOUNDATION
ELEVATION CC
ELEVATION BB
ELEVATION AA
GORDON STORAGE CURVES
NOTE
AT THE COMPLETION OF CONSTRUCTION THIS DRAWING WAS AMENDED TO REPRESENT THE FINAL ARRANGEMENT.
HORIZONTAL SECTION AT S.L.800
HORIZ SECTION AT S.L.605
SECTION FF
SECTION EE
SECTION HH
PLAN
GORDON
RIVER
ALTERATIONS

Register of the National Estate Database

[RNE search | AHC Home | Disclaimer | ©]

Gordon Dam and Lake Gordon, Strathgordon TAS

Class: Historic
Legal Status: Registered (08/07/1980)

Database Number: 101593
File Number: 6/01/109/0002

Nominator's Statement of Significance : National Estate Significance is claimed under six criteria, namely A3, A4, D2, F1, G1, and H1. Each of the criteria is addressed below.

Criterion A3: Unusual richness or diversity of landscapes or cultural features

The Dam and Lake are located in a landscape which has complex geomorphic expression and high diversity of landforms, geology, soils and biota.

There is no record of human occupation of the region and the only recorded human activity in the region was 19th century geological and survey exploration and track cutting to provide walking access from the occupied Derwent River valley to convict pining and mining settlements near Macquarie Harbour on the west coast of Tasmania. In the 20th century, bushwalkers followed the track to Port Davey south of Macquarie Harbour. The penetration of the region for construction and operation of the Dam was not only a significant change in land use but also in the recording of and access to the region.

Criterion A4: Association with stages in Australian history

Gordon Dam (and Lake Gordon) was a landmark event in that:

.it was associated with the first non-Aboriginal occupation of this previously unrecorded region of Tasmania;

.it influenced a significant phase in the economic development of the state; and

.its approval by the Tasmanian parliament and its construction were the prologue to a debate which led to significant change in federal-state relationships with regard to land use and control and development of natural resources.

A considerable number of articles, papers and books have been published on a wide range of issues associated with the Gordon River Power Development.- Stage 1.

Criterion D2: Demonstrating human activity

Gordon Dam is a state-of-the-art double curvature arch dam. It is a first class example of the

human activity which sought out and applied the advanced technology required for this type of dam. Currently, Gordon Dam is the highest arch dam, and Lake Gordon the largest water storage, in Australia.

Criterion F1: Technical excellence, innovation or achievement

Arch dams can transfer the forces on the dam due to water pressure, its own weight and changes in temperature into the rock walls and base of a valley or gorge with virtually the whole structure remaining in a state of compression. Avoidance of tension or tensile stresses in concrete dams is always a primary goal of dam builders because concrete has low tensile strength properties and is primarily used in compression, particularly in mass concrete dam structures

The technologies, which were used in the design and construction of Gordon Dam andstate-of-the-art at the time, have remained virtually unchanged in the intervening 30 years; it is therefore true to say that Gordon Dam as it stands today is a 1997state-of-theart structure. They were employed by the Hydro-Electric Commission's design and construction staff to assess, measure and achieve:

.the integrity of the rock foundations to withstand the forces imposed on them by the dam;

.the elastic properties of the rock foundations;

.a computerised version of the Trial Load Method of Analysis which had been developed by the United States Bureau of Reclamation in the 1930's to calculate stresses and deformations in arch dams.

.the construction and testing of plaster models of the Gordon Dam;

.a three dimensional finite element analysis of the final shape of the Gordon Dam;

.the concrete mix design, including the proportion of cement to be replaced by fly ash, the maximum concrete placing temperature, the maximum temperature rise after placing and the configuration of embedded piping for circulating cooling water to limit temperature rise and subsequently to reduce the concrete temperature to that appropriate for grouting the vertical contraction joints;

.the quarrying and crushing procedures to produce the sand and aggregate for dam concrete;

.the excavation procedures to excavate the steep abutments so that blasting damage to the subsequent foundations was minimised;

.the grout and drainage curtains in the abutments and below the base of the dam;

.automatic monitoring and telemetering of key parameters to a central control centre in Hobart.

Problems to be solved

Topographically, the most prominent feature was the marked asymmetry of the gorge and hence the excavated abutments. On the left abutment the average slope varied from 45 to 53 degrees to the horizontal, while on the right, the slope at about 76degrees to the horizontal was practically vertical.

Extensive geological and geotechnical studies revealed a structure which required careful consideration of the dam shape and layout to achieve adequate abutment stability on the right bank

in regard to a prominent near horizontal fault and on the left bank in relation to a series of sub-vertical faults

Innovative Solutions

Design solutions to the geological and topographic problems depended on being able to shape the dam so that internal stresses were within acceptable limits while at the same time thrust forces on the abutments were accommodated with acceptable foundation stability. The key to the design process was the computerised version of the Trial Load Analysis technique (dot point 3 above) which had been used in the design of two previous double curvature arch dams, Devils Gate and Repulse, designed and constructed by Commission resources.

With the aid of the computer program an analysis of a trial dam shape could be done using the then available computers, in a matter of hours, compared with a typical time of 3 engineer years for a similar analysis by hand. (When PC computers became available in the 1980s the time for analysis reduced to a few minutes).

This enormous productivity gain did not of itself solve the problems. However, in combination with techniques developed to 'home in' on the desired results after each successive analysis, the final result succeeded in producing

. a thin dome shape fitting the valley constraints; stresses were within acceptable limits, made so by shaping (that is, curving) the dam vertically and horizontally in order to produce a dam fitting the marked asymmetry of the site. (In similar situations in Europe, the problem of asymmetry was largely overcome by achieving greater symmetry either by excavation of rock or by casting concrete to form an artificial abutment against the valley walls on which the thrust forces from the dam were imposed. The cost of either solution would have been prohibitive.)

.abutment thrust vectors which were used to determine the amount of excavation required to fit the dam into the abutments so that stability was maintained. On the left abutment one of the faults, which was disadvantageously oriented, was completely excavated out, that is, the excavation surface for the arch abutment interface was deeper into the foundation than the fault plane. This excavation was over a height exceeding 150m and was required to be to be 'tailored' to produce a smooth plane. A line drilling technique and a controlled explosives technology was devised to achieve this.

Verification of Design

The final design arrived at by the computerised trial load analysis was checked by plaster model studies carried out in both the HECs structural laboratory and in the LNEC laboratories in Lisbon, and also by a second analytical tool called the finite element method. This analysis was carried out by Professor Zienkiewicz at the University of Swansea UK.

Lake Gordon commenced filling in 1974. Gordon Dam has continued to perform as was originally anticipated. Regular structural monitoring over a 20 year period has confirmed that the deformations are within the design limits.

The investigation, design and construction of Gordon Dam created considerable interest within the dam building community at the time, both within Australia and overseas. The Gordon Dam site was inspected by numerous national and international experts and numerous technical papers have been written about various aspects of investigation, design, construction and performance. Twenty years later these papers still attract attention in international technical publications.

Aesthetic Value

The double curvature arch design has a certain aesthetic value. Its dome shape makes a strong visual statement as viewed from available vantage points. It is possible to visualise the forces of the water behind the dam shell and the structural action between the shell and the foundations.

Criterion G1 :Highly valued for symbolic association

Gordon Dam and Lake Gordon and the associated power development has attracted a lot of public attention. Many people marvel at the size and attractive shape of the dam and when visiting the dam appreciate the opportunity to see the rugged landscape of the South West. Others see it as an intrusion in an area of significant wilderness value and an important marker in the development of environmental politics in Australia

Lake Gordon was stocked with trout at an early stage and is now a huge (in area) and satisfying (to the dedicated) trout fishery.

Criterion H1: Close association with an important figure or organisation

The Hydro-Electric Commission, Tasmania

As mentioned in the Historical Summary, Gordon Dam was designed and constructed by the Hydro-Electric Commission, Tasmania. The development of the hydro-electric resources of Tasmania began in 1911 with the construction of the Waddamana Scheme which was started by the Hydro-Electric Power and Metallurgical Company and finished by the Tasmanian Government Hydro-Electric Department. In 1930 that department became a Commission which carried out an unbroken series of power schemes for 64 years, until the last hydro-electric power development (the Anthony Scheme) was finished in 1994. The Commission was a major source of continuous employment and the cheap power it produced attracted many industries to the State. Its engineers were encouraged to try new techniques and ideas and there were many innovations along the way. The fact that the HEC was prepared to apply state-of-the-art technology and find innovative solutions to difficult problems was typical of an organisation which was renowned for its progressive approach.

The Commission not only designed and constructed power schemes; it was responsible for operation, maintenance, distribution and sales, both to major industries and retail customers. Now a Corporation, it has been and still is a very important Government Business Enterprise in Tasmania.

Association with Individuals

Being an essential component of Tasmania's power system, Gordon Dam has a strong association with Mr Eric Reece, Premier of Tasmania and Sir Allan Knight, Commissioner of the Hydro-Electric Commission.

Mr Reece was Premier for 14 years (1958-69 and 1972-75). He stood up to the full brunt of the Save Lake Pedder campaign over many years and never wavered in his determination to see the project through to a successful completion.

Sir Allan Knight obtained Parliamentary Approval for the Gordon River Power Development Stage 1 of which Gordon Dam and Lake Gordon was a vital part. Sir Allan was Commissioner and Chief Executive for over 30 years (1946-77), a period of very rapid hydro-electric development in Tasmania.

Dr Sergio Giudici was the senior designer of Gordon Arch Dam, the highest arch dam in Australia. Since then he has risen through various technical and management positions, within the Hydro-Electric Commission (Corporation), Tasmania, to his present office of General Manager Consulting providing services to the Commission and to clients within Australia and overseas. He is the premier consultant on arch dams in Australia. and a Fellow of the Australian Academy of Technological Sciences and Engineering.

United Tasmania Group (UTG) and Dr Richard Jones

This political party was formed at a Lake Pedder protest meeting in Hobart in March 1972. Its foundation document was the first affirmation world-wide of a conservationist political agenda. It strongly opposed the whole development ethics of the state. It stood candidates in the 1972 state election at short notice without success. (However both the major parties quickly came up with environmental policies after the election and the new Department of Environmental Control was established.) The Co-directors of the UTG were Dr Richard Jones and Mr Milo Dunphy. Dr Jones was the Foundation Director of the Centre for Environmental Studies at the University of Tasmania. He proved to be very politically astute and a strong leader. The UTG was wound up when people began to put their energies into the Wilderness Society which began in 1976.

Description : The place

The 135 km Gordon River rises on the eastern side of the Mount King William Range from where it flows nearly due south for approximately 45km before turning west. The river then cuts through several north-south oriented ranges before turning north west in the direction of Macquarie Harbour. The mouth of the Gordon River is at the south east, or inland, end of Macquarie Harbour. Gordon Dam is located 75 km from the river mouth in a deep narrow gorge cut by the river between the north-south trending Hamilton and Wilmot Ranges which lie to the north and south of the dam respectively. Mt Sprent (1058m) lies 10 km to the south of the dam in the Wilmot Range.

The development proposal to utilise the Gordon River also included the diversion of the headwaters of the Serpentine and the Huon Rivers into Lake Gordon to add substantially to the energy output available from the Gordon River catchment. This was to be achieved by damming the Serpentine and Huon Rivers to form a single lake, from which water would flow to Lake Gordon via a man-made canal at McPartlan Pass. The lake would flood the then existing natural Lake Pedder which name was retained for the very much larger man-made lake. The natural lake was about 10 sq km in size, and had a charming setting in the button grass plain between the Sentinel Range to the north and the Frankland Range to the south. In periods of below average rainfall the water level in the natural Lake Pedder receded to expose a beautiful white sandy beach on which light aircraft could land. An aerial prospect of the development proposal is given in Attachment A.

In 1967, when the development was approved by parliament, the land on which the dam and most of Lake Gordon are located had the status of Crown Land. The southern portion of Lake Gordon and the road to the construction village of Strathgordon lay within what was then known as the South West Fauna District. With regard to the very much enlarged Lake Pedder, the land on which it would be located had the status of a proposed Scenic Reserve which included Mount Anne and the Arthur Range to the south of Lake Pedder. The present land status is shown on the Location Map, Attachment B. Gordon Dam and Lake Gordon are on Crown Land vested in the Hydro Electric Corporation. The dam and lake are bordered to the north west and north by the Franklin-Gordon Wild Rivers National Park and to the south west and south by the South West National Park. The parks are part of the World Heritage Area, proclaimed in 1982. To the east the lake is

bordered by land classified as Deferred Forest under the management of the Forestry Tasmania.

The boundary of the Place is the contour at Elevation 310.9 metres which is three metres above the Full Supply Level of Lake Gordon.

Historical summary

Aboriginal history

About 13,000 years ago the Aborigines in Tasmania were cut off from the mainland when rising sea levels at the end of the Ice Age submerged the corridor of land now beneath Bass Strait. The people in western Tasmania were largely confined to the exposed sea coast where food could be obtained from both the sea and the land. Seasonal movements of Aboriginal groups were mostly parallel to the coast along well-defined foot paths, some kept open by regular burning.

Most of the information about Aboriginal occupation in the South-West has come from George Augustus Robinson's journeys. In 1830 Robinson was assured that no natives went inland beyond the Arthur Ranges. Aboriginal sites have been found in the Lake Gordon area but it has not been possible to date them. Robinson removed the last Aborigines from Port Davey in 1833 and from Macquarie Harbour in 1834.

European history
Vast resources of Huon pine were discovered at Macquarie Harbour and Port Davey about 1815 and a timber industry began. In 1822 a penal settlement was established on Sarah Island in Macquarie Harbour and the convicts were engaged in timber-getting and boat-building until the settlement closed in 1834. Access was entirely by sea. Of the convicts who escaped very few managed the arduous 80km journey eastwards across rugged untracked country to the nearest habitation.

In 1836 Alexander McKay and 12 convicts slashed a track from Huonville along the Huon River towards the Arthur Range. This track was later improved so that walkers could reach the plains east of Port Davey, and gain access to the Huon pine forests near the Arthur Range and the headwaters of the Spring and Davey Rivers. The cut and marked logs were carried down the rivers in floods and collected by booms at the river mouths. Some piners took their families around by boat, and at one time there were over 50 people living at Settlement Point on Port Davey.

Several expeditions were mounted over the years to explore the South-West for minerals, for arable land and for safe escapes routes for shipwrecked sailors. In 1835 Surveyors Calder and Wedge, leading a party south from the Vale of Rasselas, discovered and named Lake Pedder and travelled on down the Huon Plains to meet a boat on the Huon River. Surveyor Frankland led another party from Lake St Clair to the Serpentine River and Lake Pedder, naming Mt Anne on the way to the Huon. Surveyor James Sprent covered much of the South-West in making his trignometrical survey of Tasmania in 1845-50. Travel was never easy. Returning parties told of the wet and cold climate, thick vegetation, rugged terrain and delays at swollen rivers. All food had to be carried, as there was no hope of living off the land. In 1894, still with the plight of seamen in mind, E A Marsden was commissioned to cut a track from Port Davey to link up with the South Gordon Track near McPartlan Pass. Lake Pedder was easily accessible from this track. By the end of the century, both the pining and the whaling industries were in decline, and the piners were migrating to the mineral fields north of Macquarie Harbour.

There was also some mining, mostly on a small scale, in the South-West. Alluvial tin mining began at Cox Bight in 1892 and continued until World War 2. In 1925 an osmiridium mine was established in the Florentine Valley; the population of Adamsfield reached 2,000 in the town's first

year but it had fallen to 100 by 1927. Payable gold was found at the Jane River in 1934 and 33 men were working there in 1935. More tin was found at Melaleuca (Port Davey) in 1936 and the lease was taken over by the King family in 1941. Denis King built a small airstrip there in 1956-59, and light planes began to fly visitors and bushwalkers in and out.

Interest in bushwalking and mountain climbing in the South-West grew in the 1920s. Access was either from Huonville or Tyenna. Mt Anne was climbed in 1929. After World War 2, interest accelerated. Federation Peak was climbed in 1949. Access via logging roads enabled walkers to save a day or two on their trips. Expeditions into the South-West were very demanding but better equipment and food helped to make the cold and the wet more manageable. Light planes began landing on the beach at Lake Pedder or making food drops for bush walkers there about 1950.

In 1955 a scenic reserve called the Lake Pedder National Park was proclaimed, an area of 23000ha with the lake as its centrepiece. The Park included the Frankland Range and the hill named Scotts Peak was one of the boundary markers.

Gordon Dam is named after the Gordon River, one of the main river systems in Tasmania, first reported by Captain James Kelly during his circumnavigation of Tasmania in December 1815 in an open five-oared whale boat, the 'Elizabeth'. There is some doubt, or confusion, about the exact details of the voyage [K.M. Bowden, Captain James Kelly of Hobart Town, Melbourne University Press, 1964.]. Kelly's full journal of the circumnavigation was handed to the editor of the Hobart Town Courier in 1854; the Log reads: 'On the morning of the 30th (1815), launched and proceeded further up the harbour, until we came to the mouth of a fresh-water river. Made a sketch of it, and named it the Gordon River in honour of Mr. Gordon, of Pittwater, who had kindly lent the boat for this particular trip of discovery'.

Power development

When, in the 1950s, investigations for Gordon Dam were commenced, the area which the Hydro-Electric Commission recognised as having a high potential for significant hydro resources was unchanged from that traversed by the early explorers. The region was inaccessible and largely unexplored and it set about assessing the resource by the establishment of flow recorders on the Gordon River and of survey ground control points on mountain peaks to enable topographical mapping to be carried out by aerial survey.

From 1955 to 1966 full scale investigations were carried out using helicopters for access. The work involved the cutting of access tracks, installation of flow recorders and pluviographs, diamond drilling, excavation of adits, aerial, geodetic and topographical surveying, precise levelling and geological and geophysical mapping.

In the period 1964 to 1966 an 80 km long road was built to the dam site from the existing road and railhead at Maydena some 80km west of Hobart. The road was financed by the Federal government to enable the investigation work and the construction of Gordon Dam and the rest of the development to proceed.

The proposal to build Gordon Dam was included in the Hydro-Electric Commission's submission to the Tasmanian parliament in its report on Gordon River Power Development - Stage 1 in 1967 and approved in the same year. Construction of the dam commenced in 1972 and was completed in 1974

The proposed development was consistent with, and a continuation of, the long term policy of the Tasmanian Government and the Hydro-Electric Commission to utilise the natural and renewable hydro resources of the State to produce the electrical energy needed for industry and the

community. The submission reported on comparisons with alternative energy sources including conventional thermal power based on coal or natural gas, nuclear power generation, interconnection with Victoria and other hydro development options. Based on these studies it was concluded that the proposed development of the Gordon River was clearly the economic option and the recommendation was made that it proceed.

The construction of the Gordon River Power Development - Stage 1, proceeded as planned despite considerable debate within the community about its impact on the natural environment. The twin lakes of Gordon and Pedder filled and the Gordon Power Station began operations as planned in 1978.

Environmental debate

The submission to parliament included a recommendation for a Scenic Reserve to encompass the greatly enlarged Lake Pedder. Despite this recommendation, environmental opposition to the scheme started to make itself heard and a Legislative Council Select Committee heard submissions from the public on the scheme but the Government introduced legislation authorising expenditure on the dam before the Committee could complete its hearings. In the mean time work had started on the scheme and was proceeding on schedule. In March 1972 a meeting was held in the Hobart Town Hall to protest against the flooding of Lake Pedder. One of the key participants at this meeting was the late Dr. Richard Jones who went on to form the United Tasmania Group, the first environmental political party. The name 'Green' was adopted later.

Opposition to the scheme attracted considerable support in mainland centres, which resulted in the federal Lake Pedder Committee of Enquiry. In 1973 the Federal government proposed a moratorium on the scheme and offered to pay the costs but this was flatly rejected by the Tasmanian Premier. The Lake Pedder Committees report was tabled in the federal parliament in 1974. It analysed the environmental impact of the scheme and its implications on the process and management of developing major natural resources projects in Australia. In response to this report the Federal government ratified the World Heritage Convention which would give it extra powers over the state governments.

Post Pedder debates

A number of influential environmental groups formed as a consequence of the Lake Pedder debate. With time this resulted in significant changes in political alliances at all levels of government. The attitude to unrestricted development changed. Environmental restrictions were placed on a wide range of development projects and/or industrial processes. Conservation zones were expanded considerably. A number of important environmental campaigns was mounted to attract public attention to issues such as forestry practice, mining development, Daintree and Kakadu national parks. In the 1980s this led to one of the most significant debates on resource development in Australia; this was the Lower Gordon Dam Debate. The result of this debate was federal legislation that could override state legislation which contravened the terms of foreign treaties; that is, the World Heritage Convention as ratified in 1974.

The Hydro-Electric Commission's Report to parliament in 1981 presented several alternatives and recommended the building of the Gordon-below-Franklin Scheme. The Tasmanian Wilderness Society led by Dr Bob Brown ran a vigorous NO DAMS campaign, wanting to prevent further roads into the South-West; the Society particularly opposed the Lower Gordon Dam primarily because its reservoir would flood the lower third of the Franklin River and destroy its wild river status. The State Labor government favoured the Gordon-above-Olga Scheme which would have left the Franklin River untouched, but the government failed to convince the Legislative Council and later lost the May 1982 election. The incoming liberal government gained parliamentary

approval within a month of the election for its preferred Gordon River Power Development - Stage 2 which comprised a dam and power station on the Gordon River downstream of its junction with the Franklin River with its reservoir thus flooding both the Gordon and Franklin Rivers. The Wilderness Society immediately switched its campaign to the federal sphere.

Work on the Lower Gordon Dam was in progress when the federal election took place in March 1983. The flooding of the lower reaches of the Franklin River by the Lower Gordon Dam was one of the main election issues that contributed to a change in government. The new Federal Labor government passed legislation to stop the dam.. The Tasmanian government mounted a case opposing the legislation in the High Court which upheld, with a four-three majority, the federal legislation. The Lower Gordon Dam case is seen as a significant change in the balance of power between the Federal government and the states.

In 1994 a campaign was started with the aim of draining the Lake Pedder Storage so that the original Lake Pedder could be reclaimed. The action attracted considerable debate, both in the State and on the mainland, and the Federal government decided that the issue should be investigated by the Standing Committee on Environment, Recreation and the Arts (House of Representatives). The Committees inquiry received 140 submissions in February and March 1995 and its report was published in June 1995. The report concluded in part that the flooding of the original Lake Pedder was regarded by many to be a mistake that should not have happened. However, it also found that significant costs would be incurred in draining the present lake and that such costs could not be justified.

A considerable number of articles, papers and books have been published on a wide range of issues associated with the Gordon River Power Development. Stage 1.

Historical Biographies

People associated with the history of the area include:

James Sprent who arrived in Hobart in 1830 aged 22 was a school teacher with an interest in astronomy. He began survey duties in the colony in 1833, his work being directed to the triangulation of Tasmania. He erected and observed 206 trig stations in the period 1833 to 1847. He was appointed Surveyor General in 1858, retired the same year through ill health and died at New Town, Hobart in 1865. His son Charles Percy Sprent also became Surveyor-General and Mt Sprent (near Serpentine Dam) is named in his honour.

James Erskine Calder arrived in Van Diemens Land in June 1829 and was appointed Assistant Surveyor and made historic survey trips to the South-West in 1835 and 1837. During the latter trip he discovered and named Mt Anne (after the wife of Surveyor General Frankland), Boyd River (after Edward Boyd who became Surveyor General in 1839), Mt Wedge (after his colleague, Assistant Surveyor J H Wedge), Wedge River and Serpentine River. Perhaps surprisingly there is no topographical feature in the South-West named after Calder. After a long and distinguished career Calder died at his New Town home in Hobart in February 1882.

John Helder Wedge discovered Lake Pedder in 1835 and named it after Sir John Lewes Pedder who was Chief Justice of the Supreme Court in Van Diemens Land at the time.

British geologist Charles Gould, who was engaged to make a geological survey of Tasmania in 1859, roamed the whole area of the South-West and knew it intimately. He started the route from the Gordon River to a gap in the Frankland Range, then north east to the Thumbs and on to Hamilton. Gould left Tasmania in 1872 and died in Uruguay in 1893.

Adolphus Ibsen, an assistant of Charles Gould, was commissioned by him about 1860 to begin a track from Goulds Landing on the Gordon River south through the Wilmot Range, north east to the Gordon Bend and the end of the Dawson Road which joined up with the road from New Norfolk to Hamilton. This was probably the most important early track cut in the South-West. It became known as Goulds post track to Hamilton and was the only overland access to the mining and pining settlements at Macquarie Harbour. The postman, Francis McPartlan (see below), made the trip out and back once a month taking 4 to 5 days each way.

Francis McPartlan (1828-1888) was an Irish rebel transported to Hobart in 1847 and assigned to Sprent's survey party. This was his introduction to the South-West and his exploits in this region made him the doyen of Tasmanian bushmen. He was postman, policeman, prospector, piner, survey assistant, track cutter and bushman extraordinaire. His South Gordon Track of 1882 started at Fitzgerald, traversed the plains and McPartlan Pass to the Gordon River.

James Reid Scott, MLC. In 1881 Surveyor David Jones named a peak which he could see from the Frankland Range after James Scott. (It is uncertain whether the hill known as Scotts Peak, now an island in Lake Pedder, is the one actually chosen by Jones.) Scott made two visits to the pining areas at Port Davey, one in 1871 by McKays Track, and again in 1875 by boat when he was taken by some piners up the Davey River.

Thomas Frodsham was another government surveyor after whom Frodshams Pass was named. This was the pass through which the bushmen went on their exploratory thrusts into the West and South-West of the state; the Wedge-Calder party in 1855 was followed by James Sprent and his son, Charles, and Charles Gould in 1863 on to Edward Marsden in 1898.The purpose behind the exploration was to find access to the west and south by either road or rail to Port Davey and Macquarie Harbour.

Technical Description

Gordon Dam is a double curvature arch structure with a height of 140 m and a crest length of 198 m. Thickness varies from 17.7m at the base to 2.75m at the crest. Total volume of concrete in the structure is 154,000 cubic metres.

The horizontal arch elements are of variable radii with uniform thickness over 80% of their length and variable thickness over the 10 percent of length adjacent to each abutment. The vertical cantilever elements are also curved with significant extrados overhang near the base and intrados overhang over the upper two thirds of the dam.

The reservoir created by Gordon Dam is named Lake Gordon. At its Full Supply Level (FSL 307.9m) the lake has a surface area of 26800ha and a volume of 11.316 cubic km.

The dam is designed to store the probable maximum flood which would produce a rise in lake level of 2.44m above full supply level. For this reason, there is no conventional spillway facility. Flood water will normally be discharged through the present three turbines in the power station which have a peak discharge capacity of 205 cubic metres per second.

As the probable maximum flood has an annual exceedence probability of 1 in 1,000,000 there is only an extremely remote chance that flood water release will ever be required other than via the power station. However, if this should eventuate there are alternative procedures available to release a small flood discharge. The first is via McPartlan Pass Canal which can be used to discharge 70 cubic metres per second to nearby Lake Pedder from which it can in turn be discharged through a gated facility located at Serpentine Dam, at the north-west end of Lake Pedder. The second procedure requires several crest wall panels to be removed from the central

portion of Gordon Dam to allow a small discharge over the dam crest.

The dam site is in a narrow, deep gorge in the Gordon River valley about 160 km west of Hobart. The rock in both abutments is a chloritic meta-quartzite sequence extending from above crest level to well below the river bed. Intense and complex folding is a feature of the formation

At the time Gordon Dam was designed in the late 1960s, the various technologies required for economic design and construction of high arch dams were well advanced on a world wide basis. They could be used with confidence for dams at appropriate sites to achieve arch structures, complex in shape but extremely efficient in terms of minimising the quantity of concrete required for their construction. Typically, modern arch dams are relatively thin and of double curvature which means that the dam is curved in both the horizontal and vertical directions.

In a hydro electric development the dam is only one of the main elements. Its value lies in the potential energy of the water it retains. Other important elements are essential for the conversion of the stored energy into electrical energy which can then be conveyed by a high voltage transmission line to the a load centre from which it is distributed to industry, business and residences. These main elements comprise:

the Intake Tower which conveys the water down a vertical shaft to a horizontal tunnel which leads to the Distributor and Power Station The electricity generated is conducted up the vertical Busbar Shaft to the Switch-Transformer Yard some 198m above the power station from where it is conducted by means of the double circuit Transmission Line to Hobart;

the Distributor which connects the tunnel to each turbine; the water flows through the turbine and is discharged into the Tailrace Tunnel which conveys it back to the Gordon River some distance downstream from the dam

the Power Station, which presently houses three turbine and generator sets; space has been left to house another two sets whenever these may be required.

McPartlan Pass canal between Lake Pedder and Lake Gordon.

Gordon Dam is well maintained to the extent that after 23 years of service it can be said to be in original condition. No modifications of any kind have been carried out and none are planned.As indicated above the owner of Gordon Dam and Lake Gordon is the Hydro Electric Corporation of Tasmania, which is a Government Business Enterprise. The Dam was investigated, designed and constructed by the human and physical resources of the then, Hydro-Electric Commission. At that time the Commissioner, Sir Allan Knight, was both chairman and chief executive of the organisation. Those responsible for the work at each phase were:

Investigation Pierre Tapping, Russell Ashton, Tom Suttar, Gordon Hale
Design John Wilkins, Bill Mitchell, Mike Fitzpatrick, Sergio Giudici
Construction Ian Tulloch, Guy Ward, Ted Hofto, Derrick Waters
Allan Varty

Condition and Integrity : Gordon Dam is well maintained to the extent that after 23 years of service it can be said to be in original condition. No modifications of any kind have been carried out and none are planned. Regular structural monitoring over a 20 year period has confirmed that deformations are within the design limits.

Location : Gordon Dam is located on the Gordon River in the south west of Tasmania 8kms NE of Strathgordon and approx 160 road kms west of Hobart at grid reference easting E416000, northing N268541.

The Register of the National Estate has been compiled since 1976. The Commission is in the process of developing and/or upgrading official statements of significance for places listed prior to 1991.

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